LEVEL I

ANNOTATED BIBLIOGRAPHY OF REPORTS

SUPPLEMENT NO. 10

1 October 1977 - 30 September 1978

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NAVAL AIR STATION
PENSACOLA, FLORIDA 32508

September 1978

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ANNOTATED BIBLIOGRAPHY OF REPORTS, SUPPLEMENT 10

1 October 1977 - 30 September 1978

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30 September 1978

Naval Aerospace Medical Research Laboratory
Naval Air Station
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FOREWORD

Documents published at the Naval Aerospace Medical Research Laboratory (NAMRL) since 1 October 1977, along with three reports from fiscal year 1977, are included in this tenth annual supplement to the annotated bibliography of reports dated 30 June 1968.

With the exception of one CONFIDENTIAL report (Special Report 78-4), all numbered reports have been approved for public release; distribution is unlimited. Requests for copies should be directed to the National Technical Information Service (NTIS), Springfield, Virginia 22151. Requests for reprints of open literature documents should be addressed to the author.

Nellie R. Davis

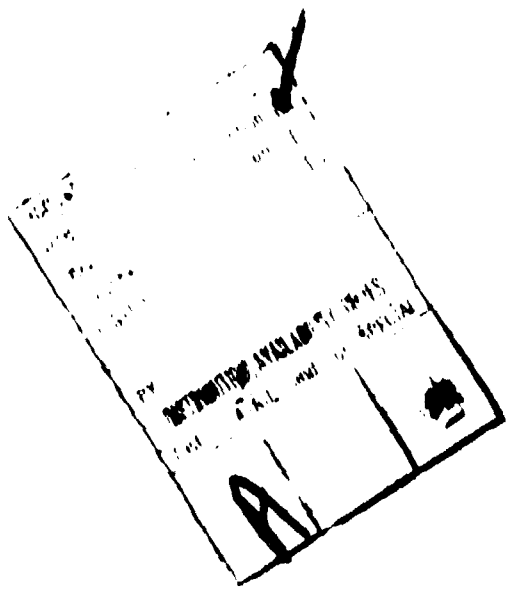

TABLE OF CONTENTS

Naval Medical Research
and Development Command

WORK UNIT

MF51.524.002-5012.2
NAMRL-1242
(AD AO49139)

An Assessment of Naval and Marine Aviation Students' Attitudes Toward Women with Specific Reference to Naval Aviation — 11/30/77

Annette G. Baisden, Rosalie K. Ambler, and Norman E. Lane

Abstract: The attitudes of Navy and Marine Corps aviation trainees toward women on several factors, including acceptance into aviation training, are considered. The results, which indicate that the attitudes of naval officers are significantly more liberal than the college normative population, are discussed in terms of their utility in the successful implementation of women into military aviation, their effect upon male participation, and their significance in a time of an all-volunteer force and continuing need to recruit.

MF51.524.004-2011.3
W43-13 8881
NAMRL-1241
(AD AO47827)

The Effects of Stimulus Orientation and Response Bias Upon Dynamic Visual Acuity — 8/19/77

Lawrence H. Frank

Abstract: In experiments on dynamic visual acuity, test stimuli are characteristically presented in various orientations to the subject as they are moved across his visual field. However, current literature on static visual acuity indicates that acuity thresholds vary as a function of stimulus orientation. Static acuity thresholds are reported to be lower for the vertical and horizontal orientations, whereas, higher thresholds are found for oblique orientations. This has been referred to as the "oblique effect."

It is not known whether the same phenomonon operates in dynamic visual acuity. Hence, it is of interest to determine whether such an effect occurs under moving target conditions. The present studies utilized the up-and-down method to determine acuity thresholds for eight orientations (4 cardinal and 4 oblique) of Landolt Cs over three angular velocities. Response-bias scores were computed for each subject and compared to the threshold data.

A significant orientation effect was found

for both dynamically and statically presented targets, but it was not an oblique effect. That is, thresholds were not consistently higher for oblique orientations. The data further revealed a significant negative rank-order correlation between the subjects' response-bias scores and their threshold scores across orientation, for dynamically presented targets. The data were suggestive that a subject's response bias contributes to the error in the measurement of psychophysically derived acuity thresholds.

MF51.524.004-5002-BX5G.10 Channel Capacity and the Locus of Interference Under Dual Task Conditions 8/31/77
NAMRL-1239
(AD A061708)

Wade R. Helm, Robert P. Fishburne, Jr., and Wayne L. Waag

Abstract: In current mission systems, naval aviators and flight officers are required to perform complex tasks under excessive pressure of environmental and task-induced stress. The effectiveness of these systems may be dependent upon the operator's capacity to process and respond to a large variety of information. There are currently no adequate measurement techniques for quantifying either human workload capacities or system's demands made upon these capacities. The use of faulty techniques and misinterpretation of available data lead to the development and deployment of systems in which the operator is severely overloaded and required to perform nearly impossible sequences of perceptual, cognitive, and manual tasks. The purpose of this study was to investigate individual's maximum information processing capacity under complex task conditions in order to provide data necessary in the development of techniques to quantify operator workload capacities and system demands.

A sample of 120 male naval officer candidates participated in two multitask experiments. The results suggest that performance on the primary task deteriorates as a joint function of both primary and secondary task processing loads. These data provide support for the maximum interference of information

processing to occur within the memory dependent and response selection stages of processing.

MF51.524.005-7026.5
NAMRL-1238
USAARL Serial No.77-19
(AD A061705)

Incidence and Cost of Orientation-Error Accidents in Regular Army Aircraft Over a Five-Year Period: Summary Report

9/28/77

W. Carroll Hixson and Emil Spezia

Abstract: This report is a summary account of the results of a joint Army/Navy study of orientation-error aircraft accidents that occurred in Regular Army aviation over a five-year period. Statistical data are presented that indicate spatial disorientation in helicopters is a significant flight hazard very comparable in magnitude to the threat generally accepted as being present with military operation of fixed wing aircraft. Of the total number of accidents that occurred in rotary wing (RW) aircraft over the study period, orientation error accounted for approximately 7.4 percent of the total, 16.5 percent of the total number of fatal accidents, 15.8 percent of the total number of fatalities, 9.4 percent of the total number of nonfatal injuries, and 10.3 percent of the total aircraft dollar damage costs. The risk associated with an orientation-error accident that occurred in a RW aircraft was also most significant in that 35 percent of these accidents were fatal. The study also provides quantitative data to validate the high accident risk (not combat losses) of combat-oriented flight operations. For aircraft of all types, the mean accident rate (accidents per 100,000 flight hours) in Vietnam was approximately 2.4 times greater than the rate elsewhere for accidents of all types, 2.1 times greater for pilot-error accidents, and 3.3 times greater for orientation-error accidents.

MF51.524.023-2004.1
NAMRL-1251
(AD A062832)

The Prevalence of Hearing Loss Among Selected Navy Enlisted Personnel

9/28/78

Ronald M. Robertson, John C. Page, and Carl E. Williams

Abstract: No reliable body of data exists on the prevalence of hearing loss among naval enlisted personnel. Such data are vitally needed, not only to determine the extent to which hearing loss exists in such specialities, but

also to further document the urgent need for implementation of hearing conservation programs throughout the Navy. Hearing threshold level data have been obtained on 3010 subjects from 16 Navy enlisted rates, 400 subjects from four apprentice groups, and 120 recruits.

The problem of hearing loss is more widespread than was anticipated. In many instances the hearing threshold levels of individuals in control group (least noise exposed) ratings and apprenticeships (HN, DN, HM, DT, MS, YN, PN, DK, TD, and AZ) approached hearing threshold levels of individuals in experimental group (most noise exposed) ratings and apprenticeships (AN, FN, EO, MM, EN, BT, AM, AD, AB, and AO). Overall, 12.5 percent of subjects in the control group and 25 percent of subjects in the experimental group demonstrated significant high frequency hearing loss. These percentages, when projected to the total population within the ratings studied, produce an estimate of approximately 32,000 personnel as having a significant high frequency hearing loss. Considering that this investigation examined only 20 percent of the approximately 80 ratings in the Navy, it is clear that the total number of naval personnel exhibiting hearing loss is indeed formidable.

M0096-PN.001-3012.1
NAMRL-1244
(AD A053161)

Motion Sickness Susceptibility: A Retrospective Comparison of Laboratory Tests — 12/13/77

J. Michael Lentz and Fred E. Guedry, Jr.

Abstract: A test battery designed primarily to assess vestibular function has been used for several years to evaluate individuals referred to our laboratory. Because some of the test conditions have proved to be nauseogenic to some individuals, methods of assessing disturbance during these procedures have been used to pursue a second goal; viz., the estimation of motion sickness susceptibility. This report, which focuses on the latter goal, is a retrospective comparison of results on three tests obtained from two groups of subjects, one of which was a group of Navy and Marine aviation personnel who had suffered multiple attacks of airsickness.

Results from three laboratory tests of motion sickness susceptibility indicated that

there are substantial differences between the airsick group and the unselected comparison group on observer ratings and individual self-ratings of motion sickness symptoms. The provocative stimuli in each laboratory test as well as suggestions concerning how multiple tests may prove effective in predicting motion sickness are discussed.

MR041.01.03.0154.1 — 8/1/78
RR 041.01.02.NR201.038
NAMRL-1252
(AD A061517)

Dynamics of an Image Viewed Through a Rotating Mirror

James E. Goodson

Abstract: It is frequently assumed that the virtual image of a target viewed through a rotating mirror moves with respect to the observer at twice the angular rate of mirror rotation. This assumption is false, and leads in imprecise treatment of open loop tracking systems. Of particular interest is a class of Dynamic Visual Acuity experiments in which acuity targets are viewed through a rotating mirror, where control of image velocity, exposure time, and image dimensions are of critical importance.

Expressions are derived which describe the direction of the target image with respect to the observer as a function of mirror position. This relationship is nonlinear, and depends upon the rotation of the mirror (A) to the observer (C), and to the target (B), and upon the included angle ($\angle$ BAC). Expressions are further derived for image velocity, acceleration, mirror intercept, and image dimensions as functions of mirror position.

XSB09.ED6.6-B1.3 — 11/7/77
NAMRL-1240
(AD A055399)

Exposure of Primates For One Year to Electric and Magnetic Fields Associated With ELF Communications Systems

James D. Grissett, James L. Kupper, Matthew J. Kessler, Richard J. Brown, George D. Prettyman, Larry L. Cook, and Toby A. Griner

Abstract: The U. S. Navy has proposed a submarine communications system that operates at extremely low frequencies. In order to more thoroughly evaluate the biological and ecological effects which could not be adequately predicted on the basis of available data in the literature, the Navy initiated an in-depth laboratory analysis. Experimental animals were

exposed for long periods to electric and magnetic fields similar to or greater than those that would be experienced by man living near the antenna. Thirty experimental rhesus monkeys were matched with thirty controls and exposed for one year.

Although not considered abnormal, the most significant finding was the difference in rate of weight gain between exposed and control males. The exposed males gained weight at a slightly faster rate than the control males and at the end of one year were approximately 11% heavier than the controls. The difference in weight was not accompanied by an increase in bone length measurements. The linear body measurement showing the most agreement with the growth rate difference was chest circumference. In the exposed females, serum triglycerides and respiratory quotient were slightly lower than in the female controls. There is no indication that these findings have any adverse clinical significance and both groups of animals appear quite healthy.

ZF51.524.002-5024.1
NAMRL-1248
(AD A060082)

Test-Retest Reliability of Individual Differences in Dual-Task Performance — 7/30/78

Robert A. North, Steven D. Harris, and Jerry M. Owens

Abstract: Recent research in predicting aviator performance in flight training from measures of divided attention performance has emphasized the need for the development and refinement of testing methods, investigation of the range and consistency of the individual differences associated with the measures, and the relationship of these measures with scores on existing paper-and-pencil tests currently used for selection of aviators.

Gopher and North indicated that there was a wide-range of individual differences in single and dual task performance of one-dimensional, compensatory tracking and a discrete, digit-processing, reaction-time task. Furthermore, there were low and non-reliable correlations between single-task performances, and generally low and non-reliable correlations between single and comparable dual-task scores for each task. These results suggested that the chosen tasks represented independent performance abilities, and that single-task performance was independent from time-sharing

performance. In addition, the individual differences demonstrated in time-shared performance were consistent across various experimental manipulations of task priorities in the study, indicating a high degree of reliability of these measures.

The goals of this study were to investigate (1) test-retest reliability coefficients of single and dual-task performance measures over separate test days; (2) the range and consistency of individual differences in the measures and degree of relationship of the attention scores to scores on a standard set of aviation selection tests, including the Academic Qualification Test (AQT), Mechanical Comprehension Test (MCT), Spatial Apperception Test (SAT), and Biographical Inventory (BI). The investigation of these relationships is an important initial step in planning subsequent investigations of the validity of these attention measures as predictors of performance in various phases of naval aviation training. Test-retest reliability is important in ensuring that changes in subject motivational levels, physiological states, or rate of skill acquisition do not bias the measurement of the skills being assessed from day to day. Relationships between single- and dual-task performance are important in determining the independence of time-sharing of the candidate from separate task performance capability. The correlation of attention measures with the paper-and-pencil tests will determine the feasibility of continuing the investigation of these measures as independent predictors of aviator performance.

ZF51.524.004-2011.4
W 43-13 8881
NAMRL-1250
(AD A060152)

Characterizing Spatial Ability: Different Mental Processes Reflected in Accuracy and Latency Scores — 8/30/78

Dennis E. Egan

Abstract: Recent experimental studies have analyzed the time to perform tasks patterned after standard tests of spatial ability. Based on these analyses, information-processing models have been developed, suggesting that subjects work through a sequence of component mental processes (e.g., code, transform, match) to perform spatial test items. If these models are correct, then response latencies, especially estimates of component-process durations, may

be the best measures of spatial ability. By contrast, traditional psychometric analyses of these tasks have consistently used overall accuracy scores as measures of spatial ability.

A model of the relationship between traditional accuracy measures of spatial ability and theoretically based latency measures is proposed. In this model overall accuracy and mean latency are viewed as composite scores consisting of the product (accuracy) or sum (latency) of component-process parameters. Three experiments investigated the relationship between spatial accuracy and latency scores, and established some psychometric properties (reliability, correlation across tests, predictive validity) of various measures.

While accuracy and mean latency scores each proved to be reliable and consistent across different tests, the two measures were virtually independent. Further analyses using component-process latency scores suggest that different mental processes influence overall accuracy and mean latency. One hypothesis consistent with the data is that spatial accuracy scores reflect the ability to accurately code a pictorial stimulus, but mean latency scores on the same items reflect the ability to mentally transform the code. Implications for ability testing are discussed.

ZF51.524.004-9017.1
NAMRL-1249
(AD A060317)

On the Assessment of Processing Demands in Complex Task Structures

7/30/78

Jerry M. Owens and Steven D. Harris

Abstract: Recent studies of human attention and information processing have successfully employed secondary probe task techniques to assess the differential demands placed upon man's "central processor" by various component task performances. Results from previous work have shown that the workload or demand associated with various tasks is dependent upon the type and extent of information processing operations upon information. However, most of the research to date utilizing probe task techniques has examined combined task performance in situations involving very simplified primary and secondary task structures. The general applicability of secondary probe task techniques for assessing processing demands in more complex task situations remains to be established.

A primary task involving successive processing operations upon information including (1) encoding, (2) rehearsal, (3) transformation, and (4) comparison-decision was performed simultaneously with a secondary probe task requiring a simple reaction time (RT) response or with a secondary probe task requiring a choice reaction time (RT) response. The two secondary tasks required different levels of capacity demands and provided a basis for evaluating the processing strategies used by subjects in the competing task demand situation. Probe stimuli occurred an equal number of times during each of the four primary task processing intervals.

Simple RT responses were performed significantly faster than choice RT responses in the secondary probe task. The increase in reaction time for choice RT responses as compared to simple RT responses was fairly constant across all processing intervals of the primary task and suggested that subjects used serial processing strategies to avoid capacity overload. Secondary task error rates increased during the comparison-decision interval of the primary task,and primary task reaction times increased when probes occurred during the transformation and comparison-decision intervals. The pattern of results indicated that demands were greater during primary task intervals requiring transformation and comparison-decision although reaction times to the secondary probe tasks did not provide a sensitive index of the increased demands. These findings suggest that procedural problems associated with controlling the allocation of processing resources to varying combined-task demands may depreciate the utility of secondary probe task techniques in complex task situations.

ZF51.524.004-9022.2
M0096.PN.001-3012
MR000.01.01-7028
NAMRL-1246
(AD A059157)

Visual-Vestibular Interactions: 1. Influence of Peripheral Vision on Suppression of the Vestibulo-Ocular Reflex and Visual Acuity

6/27/78

Fred E. Guedry, Jr., J. Michael Lentz, and Ralph M. Jell

Abstract: Legibility of head-fixed displays in some motion environments is partially dependent upon visual suppression of the vestibulo-ocular reflex (VOR). This study investigates the effects of differing relationships between

peripheral background movement and whole-body motion on the VOR and on visual performance. The purpose of the study is to explore factors in motion environments that influence performance limits and also to develop procedures of potential usefulness in evaluating interacting visual and vestibular function.

Visual performance and visual suppression of the VOR were markedly different, depending upon the relative direction of peripheral background movement. Visual suppression of the VOR and visual performance were disrupted to a far greater extent when vestibular inputs and peripheral optokinetic inputs were discordant than when they were concordant. Results have potential implications for head-up displays and suggest a procedure for evaluating visual/vestibular function.

ZF51.524.004-9022.2
NAMRL-1247
(AD A059314)

Influence of a Visual Display and Frequency of Whole-Body Angular Oscillation on Incidence of Motion Sickness — 6/22/78

Fred E. Guedry, Jr., Alan J. Benson, and H. Jack Moore

Abstract: Visual search within a head-fixed display consisting of a 12 X 12 digit matrix is degraded by whole-body angular oscillation at 0.02 Hz (peak velocities ± 155 deg/sec), and signs and symptoms of motion sickness are prominent in a number of individuals within a 5-minute exposure. Exposure to 2.5 Hz (±20 deg/sec peak velocity) produces equivalent degradation of the visual search task but does not produce signs and symptoms of motion sickness with a 5-minute exposure.

ZF51.524.005-7032.1
NAMRL-1243
(AD A053270)

Normative Data For Two Short Tests of Motion Reactivity — 12/13/77

J. Michael Lentz, Garry L. Holtzman, W. Carroll Hixson, and Fred E. Guedry, Jr.

Abstract: Reports of airsickness during aviation training are common, but many individuals experience only minor problems on a few flights. Unfortunately, severe airsickness continues in some individuals even after extensive flight training. A similar range of differences in individual reactivity to whole-body motion has been exhibited during brief exposures to motion in

laboratory testing. To the extent that these reactions reflect the degree of adjustment that will be required of different individuals in flight, laboratory measures of such reactions may prove useful in training as well as in selection. This report describes normative data for nonpilot flight officer candidates on two laboratory tests of motion reactivity.

The potential utility of the Brief Vestibular Disorientation Test and the Visual-Vestibular Interaction Test lies in identifying extremely motion sickness susceptible individuals. These individuals may have such strong reactions to motion stimuli that their success in aviation training is questionable. The highest 1 or 2 percent of rater scores can conservatively be described as representing extreme reactions to these motion stimuli, and may be predictive of difficulty in aviation training. Individuals exhibiting a strong motion reactivity on several screening tests may be more effectively trained if their initial exposures to flight are tailored to avoid sickness.

ZF51.524.015-0037.3
NAMRL-1245
(AD AO55953)

Behavioral Effects of Microwave Irradiation on Squirrel Monkey (Saimiri sciureus) Performance of a Repeated Acquisition Task — 3/6/78

T. D. Nelson

Abstract: The effect of pulsed microwave irradiation on the acquisition of new behaviors was studied with six male squirrel monkeys using a repeated acquisition task. Monkeys were repeatedly exposed to pulsed 5.62 GHz microwaves for thirty-minute periods and immediately tested on the repeated acquisition task. Compared to performance following sham irradiation, response acquisition was impaired at an incident power density of 53 mW/cm^2 but not at 11 or 43 mW/cm^2. The 53 mW/cm^2 power level produced a mean 1.9°C increase in rectal temperature above control levels and no behavioral disruption was observed without concomittant hyperthermia. No evidence of irreversible impairment of learning ability was observed. The threshold power density necessary to reliably disrupt behavior under the conditions of this experiment was estimated to be between 45 and 50 mW/cm^2.

SPECIAL REPORT

MF51.524.002-5012DX5X
NAMRL 77-2
(AD A048105)

Aviator Selection 1919-1977

10/4/77

Robert A. North and Glenn R. Griffin

Abstract: The potential for increased success in predicting aviator performance is high. The fact that current selection tests normally account for less than half of the total variance associated with aviator success (in training) suggests that there are additional factors associated with aviator performance which are not now being adequately assessed. The lack of any prominent breakthrough in perceptual/cognitive paper-and-pencil testing since the war years (WW-II) suggests that non-paper-and pencil performance tests should be investigated more fully to determine their relationship to aviator performance in both a training and operational setting.

Relating aviator performance to better and more appropriate performance measurement criteria is a continuing psychological assessment goal. New technological advancements such as the Navy and Air Force Air Combat Maneuvering Ranges have the potential to identify and reliably measure relevant physical and psychological human attributes which may provide more accurate and valid prediction of aviator operational performance.

Still, such obviously valid criteria as ACMR performance pose an interesting assessment problem. It is unclear whether the prediction variables presently utilized in aviation selection to predict successful performance in undergraduate training are related to successful performance in post-graduate operational environments.

It is suggested that research be oriented toward the identification of highly relevant criterion-oriented performance measures for use as criteria in the evaluation of present and new selection prediction variables and identification and development of non-paper-and-pencil performance prediction measures to improve prediction of criterion performance in undergraduate training, and in post-graduate operational flying environments. Examples of non-paper-and-pencil performance prediction measures

recommended for future study are Selective and Divided Attention, Stress and Anxiety Motivational Measurement, and Perceptual Psychomotor skill assessment.

NAMRL 78-1
(AD A056944)

Survival Factors in Laboratory Mice Transported By Air to Remote Laboratories — 6/5/78

R. J. Brown, F. A. Hodge, P. L. Joseph, and R. Tirtarahardja

Abstract: Laboratory mice flown by C130 Hercules aircraft had a lower mortality rate when they were rested for 80 hours between two one-day flights than when the journey was completed in two consecutive days.

ZF51.524.004-9017
NAMRL 78-2
(AD A060493)

Human Performance in Concurrent Verbal and Tracking Tasks: A Review of the Literature — 7/30/78

Steven D. Harris

Abstract: The development of voice interactive computer systems (VIS) for the control of on-board aircraft systems is expected to reduce operator workload and increase the effectiveness of naval aviation crews. A data base is needed to provide answers to human factors engineering questions arising from this development.

The research reported in sixteen major scientific journals, as well as in Psychological Abstracts, for the interval 1967-1977 inclusive, was examined for reports of investigations of human performance in concurrent verbal and continuous manual control tasks. A few readily available technical reports were also examined.

Adequate experimental data are not available to form a data base to support human factors requirements of the VIS development. A comprehensive research program is needed to determine the extent of human operator performance capabilities in time-shared verbal and manual control tasks.

M0096-PN.001-3012
NAMRL 78-3
(AD A060455)

A Manual For the Brief Vestibular Disorientation Test — 7/26/78

Rosalie K. Ambler and Fred E. Guedry, Jr.

Abstract: This report describes procedures for implementing the Brief Vestibular Disorientation Test (BVDT) which was designed to detect

individuals with extreme reactivity to disorientation stress. The procedures are brief, simple to administer, and do not require expensive equipment. The BVDT has been tested for reliability and also for validity against a pass-fail criterion in naval aviation training by the Naval Aerospace Medical Research Laboratory under sponsorship of the Bureau of Medicine and Surgery and the Naval Medical Research and Development Command.

NAVAIRSYSCOM 43-13-8881
NAMRL 78-4
CONFIDENTIAL REPORT

Performance Assessment Methods and Criteria For the Air Combat Manuevering Range (ACMR): Missile Envelope Recognition (U) — 9/30/78

C. A. Brictson, Anthony P. Ciavarelli, Ken W. Pettigrew, and Peter A. Young

Abstract: A criterion development program for the Air Combat Maneuvering Range (ACMR) is described. The technical approach includes the identification of ACMR training requirements, ACM training objectives and ACM system components. Aircrew performance measures for missile envelope recognition are emphasized and statistically described for a small sample of F4 fighter aircrews, individual pilots and A4 adversary squadrons. (U)

Methods used to develop quantitative criterion measures from ACMR output data for inflight ACM performance assessment are presented. Preliminary criterion measures for this initial research stage consist of doctrinal and empirically derived missile envelope recognition boundaries which were used to assess current aircrew ACM performance. The merits of each criterion envelope are discussed and evaluated for potential use. Envelope recognition training implications are reviewed along with present and future applications of the ACMR performance criteria under development. (U)

ZF51.524.004-2011
W 43-13 8881
NAMRL 79-1
(AD AO62134)

The Relationship Between Air Combat Maneuvering Range (ACMR) Output Measures and Initial Visual Acquisition Performance — 8/30/78

Charles W. Hutchins, Jr.

Abstract: Initial visual acquisition of the adversary aircraft is a critically important task in air combat engagements. In order to assess capabilities for the performance of this task,

it is necessary to identify the physical/ flight variables which impact this performance.

Measures of 33 flight variables were recorded at the time of initial visual acquisition. Linear regression analysis was utilized to determine the relationship of each variable to acquisition range. Factor analysis revealed a clustering of the variables into four major factors: relative direction, target velocity, fighter velocity, and relative altitude. A multiple regression analysis was conducted, using these factors to predict acquisition range.

Monograph

No. 23
ZF51.524.004-2011
F55-525-401-8881
(AD A056944)

Human Factors Engineering For Head-Up Displays: A Review of Military Specifications and Recommendations For Research

4/30/78

Dennis E. Egan and James E. Goodson

Abstract: This report is a review of Human Factors literature and military specifications concerning Head-Up Displays (HUDs). The objective is to identify important categories of Human Factors research concerning virtual-image displays. These research categories are questions that must be answered before specifications can be written for the optimal design of HUDs.

The review encompassed an exhaustive list of references available through the Defense Documentation Center (DDC) as well as other pertinent sources not given in the DDC listing. Each requirement in the General Specification for Head-Up Displays, MIL-D-81641(AS), was compared with the available data. The data base for requirements and the importance of further research concerning each requirement were qualitatively rated. Categories of necessary research were established.

Human Factors knowledge has not kept pace with the proliferating uses of HUDs and the expansion of HUD technology. Consequently, the majority of existing Human Factors specifications for HUDs are based on expert opinion rather than empirical data. Several categories of research are required to provide an adequate data base for future specifications, and to understand how specific issues in the design of HUDs affect performance.

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